GRAHAM
SUSTAINABILITY INSTITUTE
UNIVERSITY OF MICHIGAN

Why Do Lake Levels Matter?

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University of Michigan Graham Sustainability Institute

State of Lake Michigan Conference – 2015
Lake Michigan Track II
Coastal Resiliency

Presentation Overview

- **About the U-M Graham Sustainability Institute**
- **Research Methods (Integrated Assessment)**
- Water Levels Research Efforts
  - Process
  - Shoreline Property Owner Survey
  - Science Outreach
  - Planning Grants
  - Next Steps

Graham Institute & U-M

Centers:

- Climate
- Integrated Assessment
- Water

Programs:

- Scholars (57)
- Fellowships (78)
- Campus Stewardship
- Faculty Support

Common Principles:

- Scientifically Rigorous
- Interdisciplinary
- Engaged with Practice
- Collaborative
- Inclusive & Diverse
- Local to Global

U-M *Planet Blue Ambassadors* (students, staff & faculty) completed 17,000 action pledges, reducing 5 M lbs. of greenhouse gas emissions, preventing 250 lbs. of landfill waste, & saving 5 M gal. of water – FY 15

Integrated Assessment Research

Assessments

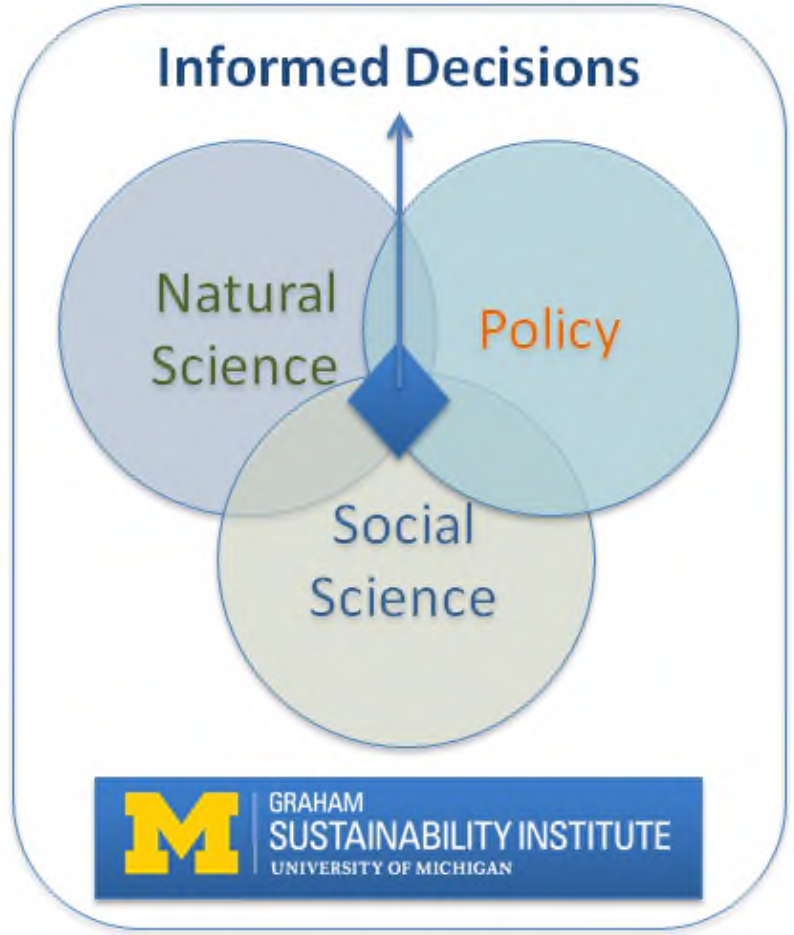
Collaborative teams review and analyze existing research and data related to a specific issue.

Integrating

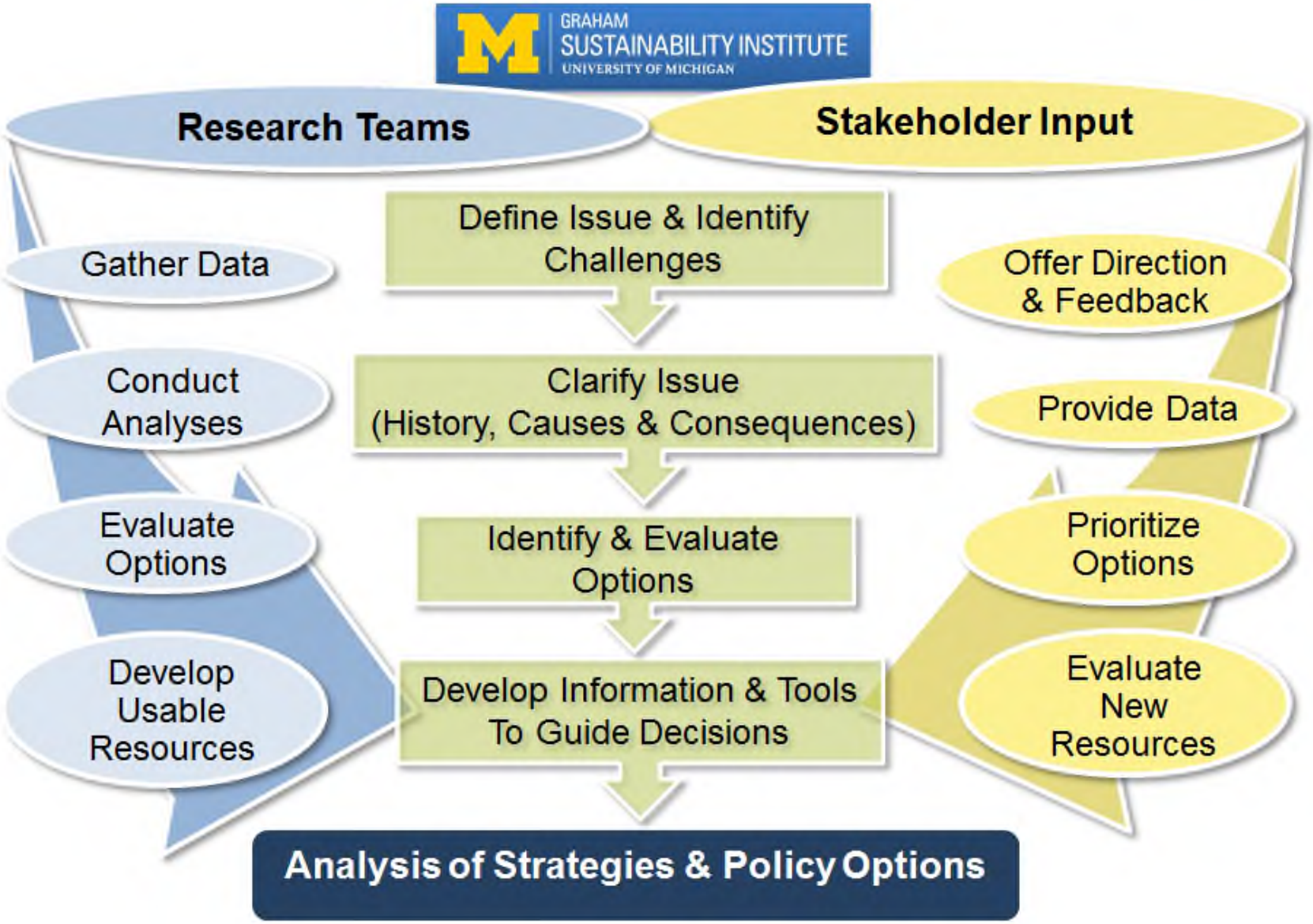
- Policy or management context
- Diverse stakeholder perspectives
- Multiple disciplines
- An analysis of causes and possible solutions

To

- Build consensus and inform decisions



Integrated Assessment Research Process



Presentation Overview

Water Levels Research Efforts

- Research Process
- Shoreline Property Owner Survey
- Science Outreach
- Planning Grants
- Next Steps

Research Process

Scoping & Development

- Stakeholder mapping
- Shoreline property owners survey
- Develop advisory committee

MDEQ, Office of the Great Lakes	U.S. Army Corps of Engineers	Ducks Unlimited	Wisconsin Harbor Towns Association
ODNR, Office of Coastal Management	Environment Canada	The Nature Conservancy	W. Michigan Shoreline Regional Dev. Comm.
Conservation Ontario	Ohio Lake Erie Commission	Georgian Bay Forever	Save our Shoreline
International Joint Commission	Wisconsin & Michigan Sea Grant	Council of Great Lakes Industries	Great Lakes Coalition

Research Process: Guiding Question

Guiding Question (based on scoping):

What environmentally, socially, politically, and economically feasible policy options and management actions can people, businesses, and governments implement in order to adapt to current and future variability in Great Lakes water levels?

Key Impact Areas:

- Infrastructure
- Water Quality
- Recreation & Tourism
- Shoreline economies
- Nearshore & coastal habitat

Research Process: Purpose & Focus

Purpose:
Help equip the region with a robust set of adaptive strategies for addressing fluctuating water levels to protect the ecological integrity, economic stability, and cultural values of the region.

Focus:

- Lakes Michigan-Huron & Erie
- Identify & evaluate adaptive management options (not lake level control structures)

Research Process: Considerations

Local (place-based):

- Evaluate specific, integrated, and feasible options
- Engage local stakeholders
- Build local ownership

Regional:

- Identify opportunities for wide variety of shorelines and issues for lakes Michigan-Huron and Erie

Research Process: Interdisciplinary

Environmental	Social	Political	Economic
• Climate change • Hydroclimate processes/ modeling • Shoreline stability • Slope erosion • Ecosystem dynamics • Habitat	• Effects of shoreline management activities on neighboring properties • Distribution of costs and benefits of water level impacts and shoreline management activities • Changes to the culture/feel of a community • Education/communication and outreach/engagement • **Resiliency planning**	• Shoreline or floodplain building and zoning regulations • Shoreline or floodplain planning • Land conservation • Decision tools	• Property values • Property damage • Decreased business revenue • Increased operating expenses • Incentives • Financial planning and budgets

Project Schedule: 2015-2017

Planning Grants: 7 Teams

Purpose:

Identify appropriate locations, interested partners, and existing data to determine feasibility of a larger research project.

Planning Grants ($70K)

- **Threatened and Endangered Species Habitat – Emmet County, MI**
  Dennis Albert, Oregon State University (PI); Paul Drevnick, U-M
- **Adaptive Management – Huron County, ON**
  George Arhonditsis and Vincent Cheng - University of Toronto at Scarborough; Lynne Peterson, Consultant; Agnes Richards, Environment Canada
- **Visualization & Scenario Planning – Regional**
  Adam Fenech, University of Prince Edward Island; Daniel Scott, University of Waterloo; Colin Dobel, Ontario Water Center
- **Tribal Fisheries – Regional**
  Frank Marsik (PI) and Richard Rood, U-M; Kyle Whyte, Michigan State University
- **Coastal Bluffs & Shoreline Planning – Ozaukee and Milwaukee Counties, WI**
  David Hart (PI), Jane Harrison, and Adam Mednick, Wisconsin Sea Grant; Bruce Bessert, Concordia University; John Janssen and Jenny Kehl, University of Wisconsin-Milwaukee; Jim LaGro, David Mickelson, Brian Ohm, and Chin Wu, University of Wisconsin-Madison
- **Stakeholder Perceptions – Grand Traverse & Leelanau Counties, MI**
  Hans VanSumeren (PI) and Constanza Hazelwood, Northwestern Michigan College
- **Land-use Regulation and Infrastructure Policy – Regional**
  Richard Norton, U-M (PI); Guy Meadows, Michigan Technological University

Presentation Overview

- **Shoreline Property Owners Survey**
- Science Outreach
- Next steps

Survey Goals

Goals:

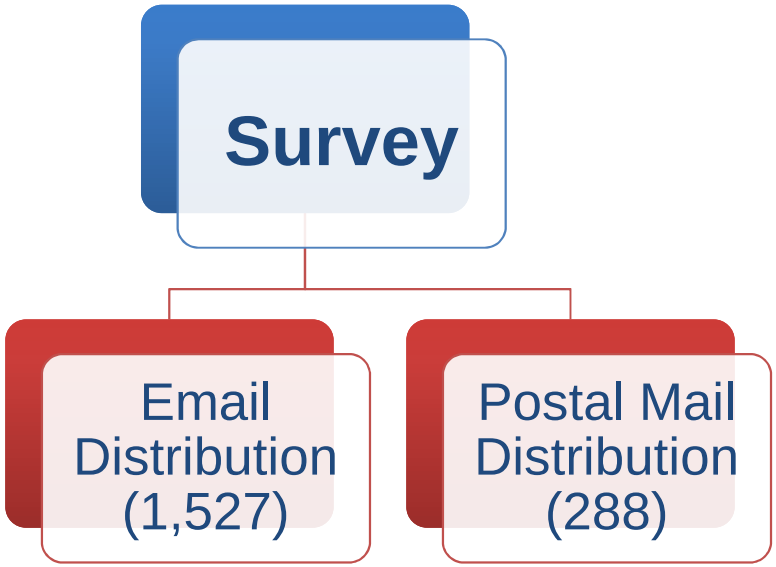
- Inform the direction & scope of the research efforts
- Collect data on perceptions of water level change

Information we want from stakeholders:

1) The level of concern about water level change
2) How water level change and extreme water levels impact property owners and managers
3) What people believe about water level change
4) How to best reach people with usable information

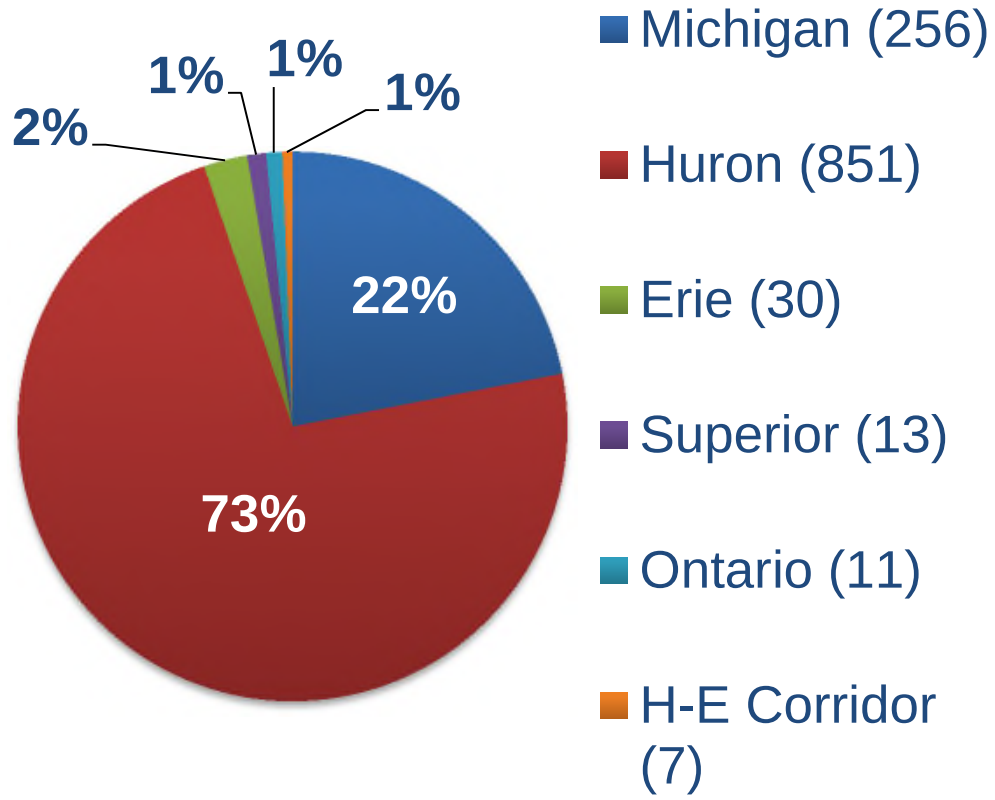
Conducted by: Rachel Jacobson (MS/MPP, currently at NOAA PPI)

Survey Response



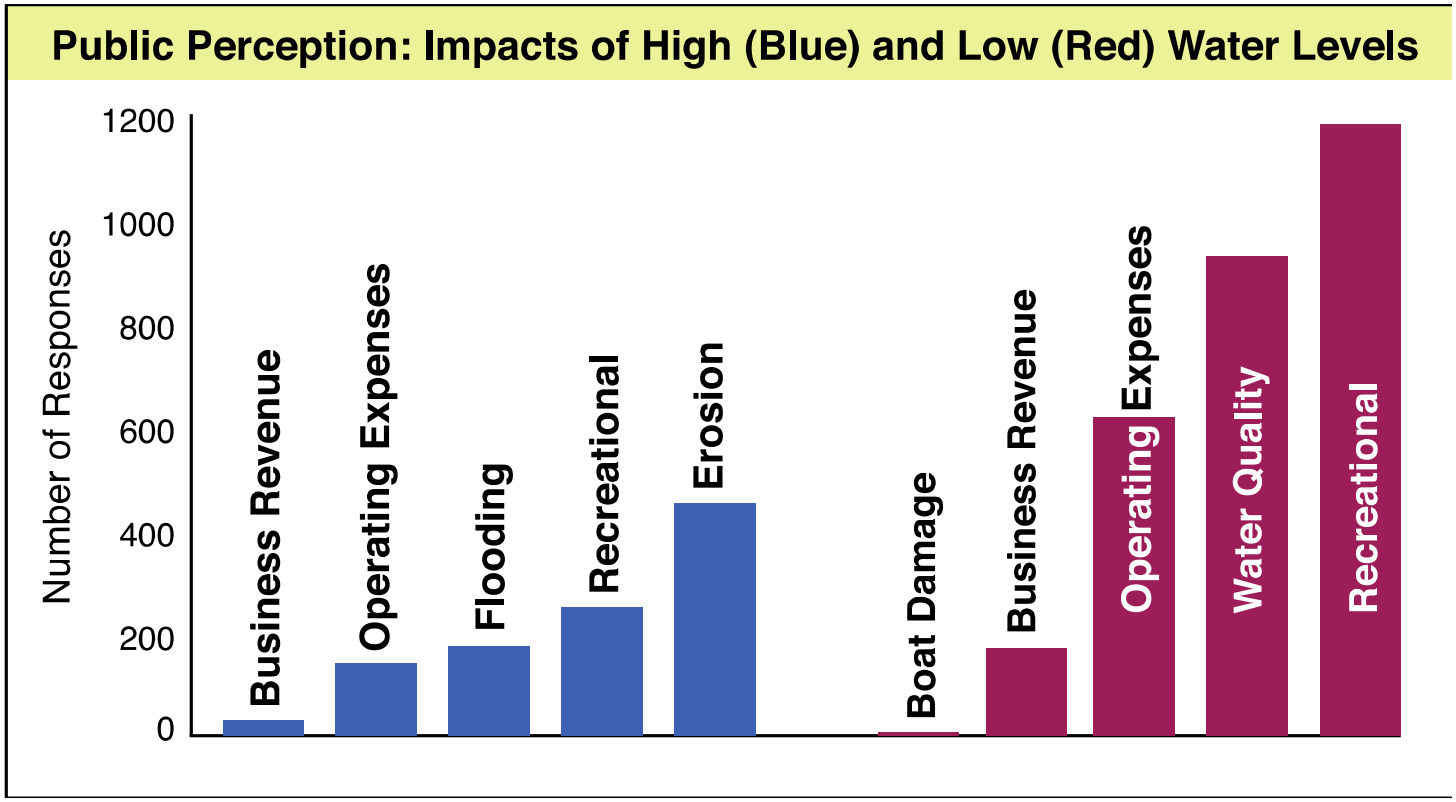
- **1,815** Responses
- **70%** Property owners
- **90%** Residential

Responses by Lake Location



Jacboson, 2014

Survey Results



Participant concerns:

- Property damage during high water levels (blue); and a decrease in recreational opportunities during low water levels (red)

Graham Sustainability Institute, adapted with permission from Jacobson (2014)

Responses

Perceptions:

- High water levels = negative impacts (majority)
- Low water levels = negative impacts (50%)
- Ranking – How humans impact water level changes: (1) diversions, (2) structural controls & (3) dredging

Why Do Water Levels Matter?

Science Outreach Strategy:

- Summarize key issues, stakeholder perceptions, current science and data (average water levels over time)
  - Address misconceptions & knowledge gaps:
    - Illinois (Chicago) diversion is “huge”
    - Water level monitoring is not accurate
- Explain how monitoring is done, how data is collected, who does it, and accuracy
- Present information about climate change and monitoring challenges (over lake evaporation)

Outreach Methods

Develop Two Summaries & Vet with Experts

Collaborative Group

- Water Level Experts (U-M & GLERL) & Graham Staff
  - Iterative process writing & review

Dissemination

- Supported Research Teams (Planning & Phase 1)
  - Share with Stakeholders & End Users
- Graham Website
  - Water Levels Project Webpage
  - Social Media
- Partners (MDEQ)

Addressing Perceptions

Knowledge Gaps

Survey participant perceptions:

- The top three ways humans impact water levels: (1) Diversions, (2) structural controls, and (3) dredging

Fact:

- Amount of water leaving the system through diversions is quite small

Example: (1953-2010)

- Illinois diversion H_2O (near Chicago) avg. loss = -90 cubic meters per second (CMS)
- Avg. rate H_2O entering Lake MI-HU, via precip. & runoff = 5,800 CMS
- Avg. amount H_2O entering Lake Superior (Ogoki & Long Lac diversions) = 160 CMS

Summary 1: Water Budget

Values shown:
Thousands of cubic meters per second (CMS) for each lake.

Averages (1953-2010):
Evaporation (e), Precipitation (p), Runoff (r), and Artificial Diversions

Figure modified by the Graham Sustainability Institute from original, used with permission by Michigan Sea Grant.

Data source: NOAA-GLERL
Hydrometorological database

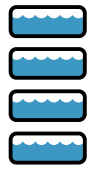
Summary 1: Water Budget

Values shown:
Cubic meters per second (CMS), converted to gallons per minute, compared to an Olympic swimming pool.

Amount water diverted into and out of the GL system (1953-2010 averages).

Lake Superior & Lake Michigan-Huron Diversions

Diversion In (Ogoki & Long Lac)
160 CMS = Approx. 4 Olympic Swimming Pools Per Minute



Diversion Out (Illinois) 90 CMS = Approx. 2 Olympic Swimming Pools Per Minute

Olympic Swimming Pools = Approx. 660,000 Gallons of Water

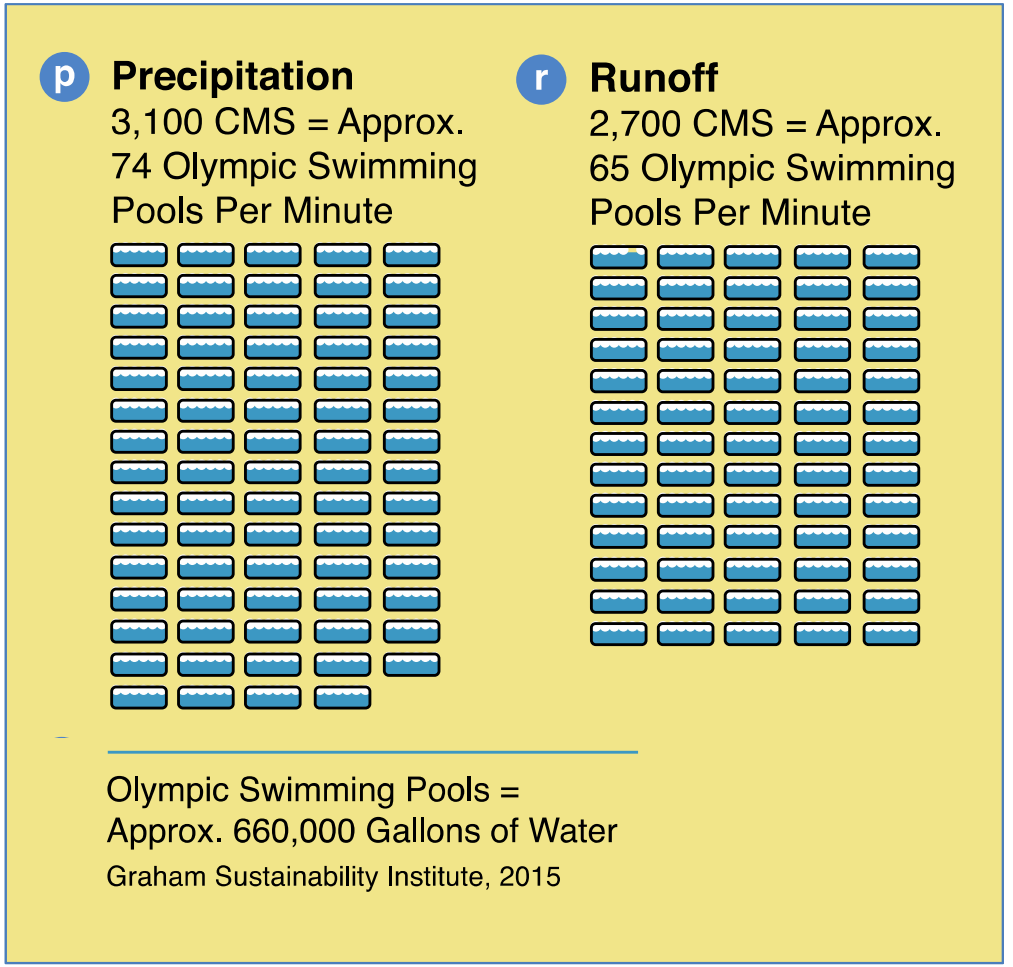
Graham Sustainability Institute, 2015

Summary 1: Water Budget

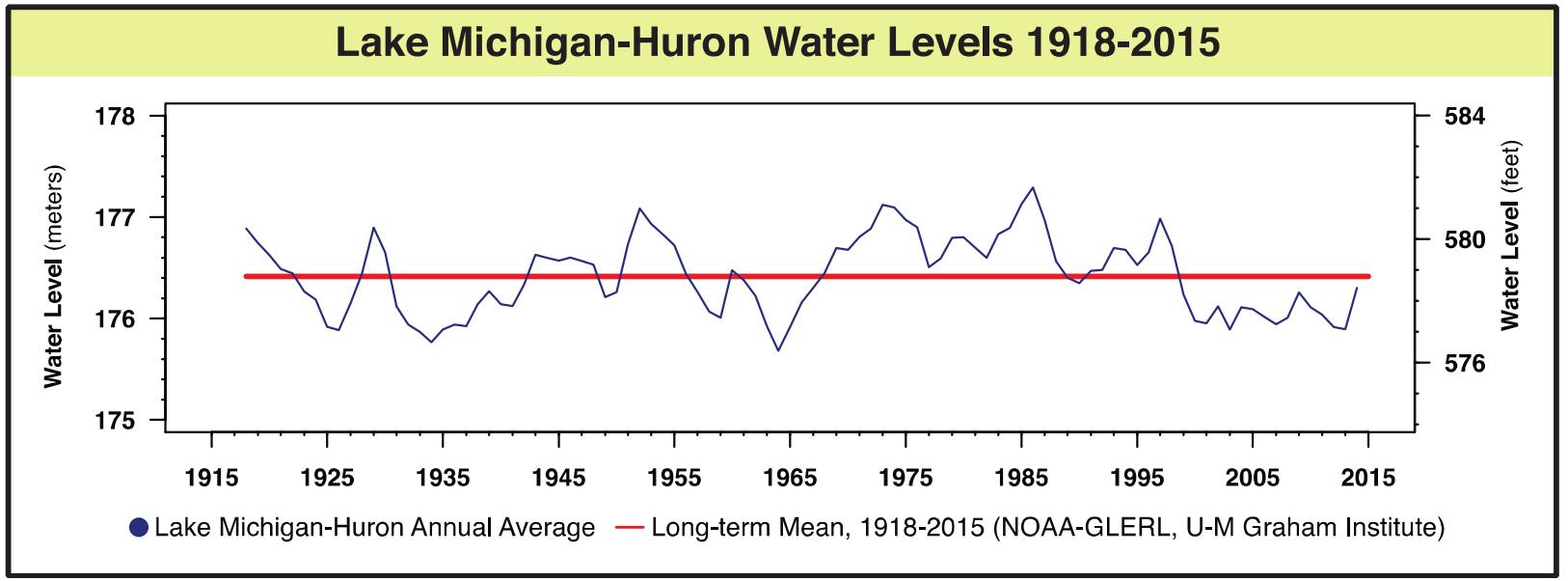
Average Amount of Precipitation and Runoff into Lake Michigan-Huron (1953-2010)

Values Shown:

Converted from CMS to Gallons Per Minute.



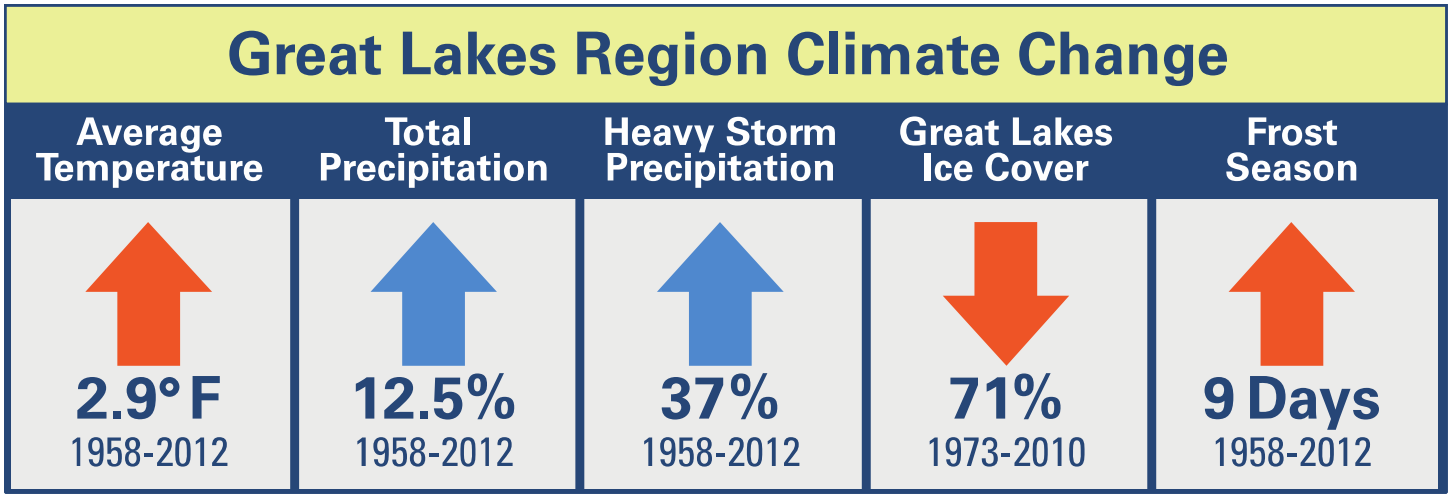
Summary 2: Water Levels



- Lake Michigan-Huron water level fluctuations (1918-2015)
- Note long period of low water levels (late 1990s to 2013).
- Despite rapid rise in levels since 2013, lakes are still well below the highest level recorded (mid-1980s)

Data: NOAA CO-OPS, the Canadian Hydrographic Service, USACE, and Environment Canada (courtesy of NOAA GLERL)

Summary 2: Water Levels



Ice Cover:

- Additional key factor that impacts water levels
- Ice cover data is not available prior to 1973, and not yet available from 2010-present.

Figure adapted by the Graham Institute, with permission from the UM Climate Center.

Summary 2: Preparing for the Future

- **Consider:** How we may better prepare for the extremes of high and low water levels

- **New strategies:** Address how we may better adapt to Great Lakes water level variability:
  - Sound planning efforts
  - Consider variable water levels as part of anticipating vulnerabilities
  - Preparing for extremes and adapting accordingly

Summary 2: Water Levels

Monitoring Lake Levels

- More than 150 years of data
  - **1860:** USACE began monitoring levels
- NOAA Center for Operational Oceanographic Products and Services (53 water level stations)
- Canadian Hydrographic Service (33 stations)

Water levels are precisely measured and recorded every few minutes.

- **Binational Partnership:** USACE and Environment Canada coordinate water level data and seasonal forecasts through a, as part of their operational duties related to Great Lakes water management
- **Predictions:** These and other agencies (NOAA-GLERL), use water level data to conduct research and improve models that help predict water level fluctuations

Summary 2: Water Levels

Coastal Resiliency

The Great Lakes region, a focal point of NOAA's nation-wide effort (reducing current and potential future risks for coastal communities)

Key Priority: Implement actions that promote adaptation to changing environmental conditions, and address disaster preparedness.

Presentation Overview

- Graham Sustainability Institute
- Integrated Assessment
- Water Levels Integrated Assessment
  - Process
  - Shoreline Property Owner Survey
  - Outreach Materials
  - Planning Grants
  - **Next steps**

Next Steps

Phase 1

- **November 2015 – April 2016:** Teams provide interdisciplinary overview synthesis and reports of status, trends, causes, and consequences of projects

Phase 2

- **May 2016 – October 2016:** With stakeholder input, teams develop reports analyzing viable policies and adaptive actions

Local

Phase 3

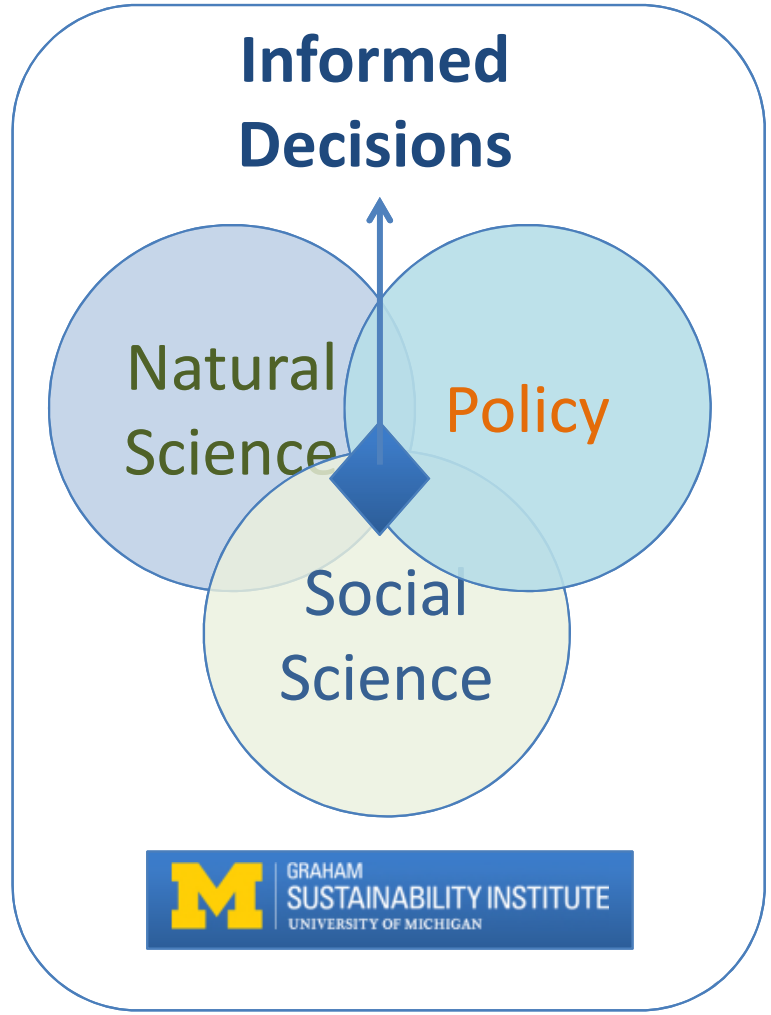
- **November 2016 – April 2017:** Teams work with Graham personnel to develop final comprehensive reports of select options

Regional

Next Steps: Address Guiding Question

Answer Guiding Question:
What environmentally, socially, politically, and economically feasible policy options and management actions can people, businesses, and governments implement in order to adapt to current and future variability in Great Lakes water levels?

Purpose:
Help equip the region with a robust set of adaptive strategies for addressing fluctuating water levels to protect the ecological integrity, economic stability, and cultural values of the region.



Thank You!

Water Levels Advisory Committee

- Jon Allan, Director, Office of the Great Lakes, MDEQ
- John Allis, Chief, Great Lakes Hydraulics and Hydrology Office, US ACOE, Detroit District
- Mark Breederland, Extension Educator, Michigan Sea Grant
- Matthew Child, Deputy Director, IJC, GL Regional Office
- Gene Clark, Coastal Engineering Specialist, Wisconsin Sea Grant
- John Coluccy, Director of Conservation Planning, Ducks Unlimited
- Patrick Doran, Director of Conservation for Michigan, The Nature Conservancy
- Bonnie Fox, Manager of Policy and Planning, Conservation Ontario
- Gail Hesse, Executive Director, Ohio Lake Erie Commission
- Erin Kuhn, Executive Director, W. Mich. Shoreline Regional Development Commission
- Wendy Leger, Physical Science Senior Officer, Environment Canada
- Scudder D. Mackey, Chief, Office of Coastal Management, Ohio DNR
- David Powers, Attorney, Smith, Martin, Powers & Knier, Save our Shoreline
- Larry J. Robson, Board Chair, Great Lakes Coalition
- Ana Sirviente, Program Development Director, Council of GL Industries
- David Sweetnam, Executive Director, Georgian Bay Forever
- Kathy Tank, President, Wisconsin Harbor Towns Association

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Water Level Resources:

- *Graham Institute Website:* graham.umich.edu (Integrated Assessment / Water-levels)
- *NOAA-GLERL Website:* glerl.noaa.gov (now/wlevels/levels.html)

Contacts:

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- John Callewaert, Program Director, jcallew@umich.edu